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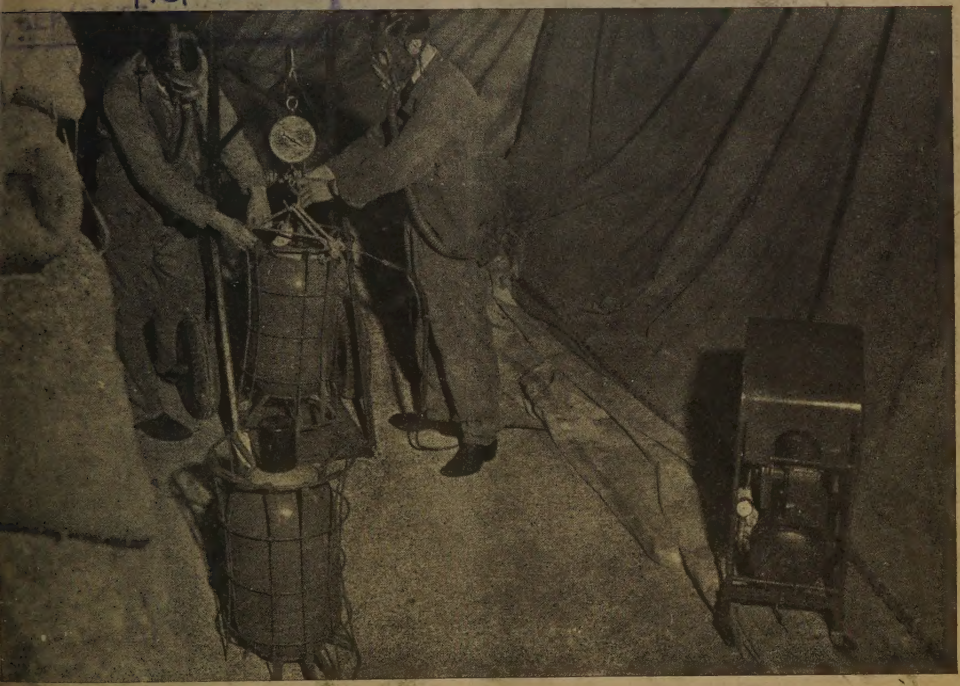

Fumigation with Methyl bromide

ISSUED BY THE PLANT PROTECTION ADVISER TO THE GOVERNMENT OF INDIA.
NEW DELHI

NOTE

Plant Protection Bulletin is intended to keep all Plant Protection workers in India informed of the progress of control work on plant pests and diseases in different parts of the country and of the advances and developments in Plant Protection work in other parts of the world. Suitable articles, reports, notes observations and comments received from workers all over India will be published in the Bulletin. The notes from correspondents may also be in the form of suggestions, queries and opinions, even tentative, offered for discussion or consideration. The reports should in particular, contain information on the sudden outbreak of diseases or pests or the equally sudden disappearance of other diseases or pests from a particular area. The progress made in spraying, dusting and other methods of disinfestation should form a prominent part of the reports. The intensity and severity of a disease or pest, or the absence of a pest or disease from a particular area and the prevalent conditions should be noted. If some varieties of a crop are not affected by a disease or pest, whereas others occurring in the vicinity have been attacked by them, then such information would be extremely useful. In reports containing control operations against pests and diseases, the cost of these operations and the savings obtained therefrom must be invariably stated. In accepting and publishing any material received from contributors, the Directorate of Plant Protection, Quarantine and Storage serves merely as an informational clearing house. It does not assume responsibility of the subject-matter.

Any suggestions for the improvement of this Bulletin will be gratefully received.

HEM SINGH PRUTHI,
Plant Protection Adviser to the Govt. of India.

OPENING OF PLANT QUARANTINE AND FUMIGATION HOUSE AT BOMBAY

A Plant Quarantine and Fumigation Station which is the first of its kind in India was opened at Sewri, Bombay by the Hon'ble Shri K. M. Munshi, Minister for Food and Agriculture on 24th December, 1951.

SPEECH OF THE HON'BLE MINISTER OF FOOD AND AGRICULTURE

Shri K. M. Munshi spoke as follows :—

"It gives me great pleasure to be here this evening in order to perform the opening ceremony of this Plant Quarantine and Fumigation station. Dr. Pruthi has already told you that this Station is the first of its kind not only in India but perhaps also in the whole of Asia. You know very well that we are just beginning to have comprehensive review of our problems and with the difficulties which we are facing, we naturally have not only to look to one way of becoming self-sufficient but also several other ways. For instance we have been striving for Grow More Food, but we forgot to strive for *Save More Food.* That is one great thing which we have to achieve because growing of more food by giving more water to land, applying improved and scientific methods of Agriculture is a much more difficult process than saving what you have already got".

2. Continuing the Hon'ble Shri Munshi remarked that he made a study of the food problem almost in the beginning of his joining the Ministry and found that our efforts to avoid losses to crops were very small. In explaining this he said that "our greatest loss, as Dr. Pruthi has already told you, arises out of pests and diseases. In foreign countries like U.S.A. etc., the percentage of this loss is something about 20 to 30 per cent. You can imagine the huge losses which in India we are having as the climatic conditions permit here for much more rapid multiplication of pests. They are at least about twice as much as what we are now importing. Thus even if we prevent half the losses, we can immediately stop further imports".

3. Commenting on the destruction caused to crops by monkeys and wild birds, Shri Munshi remarked that "it is our extraordinary way in which we treat this class. We assist the development of such wild animals rather than destroy them and it is due to this that their number had considerably increased. In Utter Pradesh there is a kind of animal which by accident was called 'neel gau'. In fact it is neither a cow nor blue in colour. It is a highly destructive animal but our people do not care to kill it because it is called a 'cow'. The Utter Pradesh Government has wisely changed its name and this animal is now called the 'neel gohra' instead of 'neel gau'. These are the facts which we are to face. About one million tons of food which costs us about 35 crores of rupees is being eaten up or destroyed by this pest.

4. Comparing the food production and population of various countries of the world after he had an occasion of studying the food situation in the world during his recent visit to Rome, the Food

Minister said that "you will be surprised to know that North America is the only country which is the granary of the world; East Asia has got 70 per cent. of the population and 34 per cent. of world's production; U.S.A. and Latin America have 20 per cent of population and 25 per cent. food production. Afghanistan is self-sufficient. Pakistan, Burma and Thailand are surplus. Indonesia is almost equal, China is also surplus. Malaya and Ceylon are deficit but deficit in a very small way. The two major countries which require 5 million and 3 million tons a year are India and Japan respectively. In order to prevent a collapse and a calamity and to have sufficient available food for the people of this country, we must pay early attention to plant protection work which plays such an important part".

Referring to the natural losses to crops due to droughts, earthquakes etc., the Food Minister said that locust was still another. "Locust cycle began last year and swarms went all over India, something like 75,000 sq. miles were infested by the young hoppers of those foreign visitors. They know no frontiers and no passports are issued to them. So far as these pests are concerned they are international citizens. They travel without passport. They come without permission. Millions and millions start from somewhere either from Africa flying down to Arabia and Iran and then crossing Pakistan into India without any permission. This is a very serious cycle. Without the efforts of the Directorate of Plant Protection of my Ministry led by my friend, Dr. Pruthi, losses to crops would have been tremendous."

6. "Similarly in regard to other Plant Protection work that has been done in various States in this country, the Central Directorate has played a very important part. We have been able to keep out pests in about 25,00,000 acres of different crops. Dr. Pruthi has told you about the Fluted Scale which was of Australian origin and with which we have dealt very successfully. This pest was a great danger to U.S.A.'s citrus industry, but luckily we have killed these invaders and prevented their growth in this country".

7. Shri Munshi then emphasising the need of educating the farmers said that "our farmer is not very conscious of the very vital part that control of diseases and pests play in food production. He has not got the money to get the insecticides and other equipments necessary for it, which are all imported. We are now trying to get insecticides and equipment from America so as to help our farmers. At the same time we are planning to get pesticides manufactured in India. That is another activity which we are undertaking and I have no doubt that we would be able to show some results in the times to come".

8. Again referring to the part which the Plant Quarantine and Fumigation Station will play in this country, the speaker said that "it will prevent from bringing the outsiders to our country and increase the value of our export. Dr. Pruthi has already told you how we are getting all kinds of pests like Cotton boll weevil and Colorado potato beetle. These are very serious pests, which if allowed to come will establish in this country and would result in

great damage to our crops for all times. This is the first Station of its kind and I hope and trust that it will achieve the success it deserves. A small Station is already being established in Madras. We are also to take measures with regard to the huge land frontiers between India and Pakistan and we will have to put Stations there to save our crops. Before declaring open the Quarantine Station, I must congratulate Dr. Pruthi and his staff who have been working towards this end and I hope that the country will benefit from their efforts".

Introductory remarks of the Plant Protection Adviser

In his introductory remarks Dr. Hem Singh Pruthi, Plant Protection Adviser to the Government of India stated as follows :—

"Insect pests, plant diseases, rats and wild animals cause heavy damage to agricultural crops and forests in all parts of the world. In cold countries like the U.S.A., U.K., etc., where detailed counts have been made it is estimated that on an average such losses amount to 20 to 30 per cent. of the crops grown, harvested and stored. In tropical and sub-tropical countries like India, where climatic conditions are more conducive for the rapid multiplication of such organizms, the losses are much higher. For example, there are records of locusts having caused famines. In recent years (1943) a single disease of paddy proved to be the most important immediate cause of the famine in Bengal. Even a very conservative estimate of such losses at 20 per cent means that about nine to ten million tons of foodgrains alone are being wasted every year in this country. These staggering losses are therefore about twice as much as our maximum imports during the recent years.

2. It is well known that many of our most serious pests and diseases are those which came from foreign countries on imported plant materials. It is a biological phenomenon that introduced pests multiply and cause greater losses than the indigenous species because the latter are living in equilibrium with their natural environment. Some examples of exotic pests now established in this country are the notorious San Jose Scale, potato tuber moth, woolly aphis, the tea blight, some sugarcane borers and cotton boll worm. Fortunately, however, we are yet free from some of the most injurious pests of the world. Of these, I may mention, the Mediterranean fruit fly, the Hessian fly of wheat, the cotton boll weevil, the tobacco caterpillar, the coffee borer etc. Even if discovered early, soon after their entry, their eradication costs huge amounts. For example the eradication of the Mediterranean fruit fly in a small tract in U.S.A., cost several million dollars. Once the foreign pests get established, it becomes impossible to get rid of them and can only be kept under control at heavy expenditure every year.

3. Almost all the western countries took early steps to formulate quarantines in order to stop the entry of foreign pests into their territories and for this purpose established quarantine and fumigation stations for examining imported plant materials and disinfesting those carrying pests by fumigation and other methods before permitting their actual importation. In India, we made rules some years ago under which some importations were prohibited altogether and others for want of proper technical personnel and equipment

available at the ports were fumigated wholesale without examination by untrained staff. The result was that not only the trade was unnecessarily hindered but the plants got either low dosages or excessive dosages, and above all even healthy plant materials were fumigated. Thus while some pests escaped the treatment and got entry into the country, in case of heavy dosages the plants and insects got killed together. Government of India, therefore, decided to establish modern and properly equipped plant quarantine and fumigation stations to start with at the main sea ports of India and Sir, you have kindly agreed to open today the first one in the series. The ceremony, therefore, marks an epoch in the development of agriculture in this country as this Station is not only the first of its kind in India but also in whole of the non-European world and compares favourably with any similar station so far established in the most advanced western countries.

4. This station has a supplementary laboratory at Poona on the estate of the College of Agriculture, where arrangements are being made to grow under quarantine conditions plant materials suspected of carrying diseases. The material found diseased will be immediately destroyed before the causal organism would become capable of spreading to local crops.

5. However, it may be stated that our defences will be incomplete if we do not have immediately similar stations at other main ports of the country such as Calcutta, Madras and Cochin, otherwise it will be most irksome to the trade and impossible in practice to canalise all their imports through Bombay. Some arrangements have been made at Madras particularly with regard to cotton imports. But the most important step which has yet to be taken in the sphere of quarantine is at the land frontiers. Several countries touch the Indian borders and, therefore, many of our notorious pests and diseases of food crops such as paddy, sugarcane, etc., have come via land routes from S.E. Asia. In the western direction, we have to take very early steps to make arrangements to stop the entry of a very serious pest of wheat (Eurygaster bug) which destroys this crop over large areas in southern Russia, Persia, etc. Some years ago, it entered Baluchistan area of Pakistan, and is fast approaching the Indian borders. As a matter of fact, it is suspected that some specimens have already entered some sub-mountainous districts of the East Punjab.

6. The Station at Bombay and those which we would establish at other ports can also be used for treating some of our dollar earning commodities which are required by importing countries to be disinfested before export. There is a general complaint in the western countries particularly U.S.A., that our cashewnuts, groundnuts and other oil seeds, spices, psyllium, etc., are found heavily infested. The payments due to Indian exporters are cut down on account of the 'cleaning' measures undertaken by the importers before permitting their entry. Moreover, in view of the fact that it is well known in Europe and U.S.A. that this country has at present no arrangements for disinfesting her exports, the quotations received for Indian commodities in general are comparatively low on account of their being considered as "wormy".

GENERAL FUMIGATION WITH METHYL BROMIDE UNDER GAS-PROOF SHEETING

Methyl bromide with two per cent. of Chloropicrin added as an indicator and safety factor is now normally used for fumigating wheat, barley and oats for the control of rodents and insects in England. This fumigation is carried out under the direction of the Infestation Control Division, Ministry of Agriculture and Fisheries, England and Wales.

The cereals in bags are first built up on a concrete floor in stacks; 3 sacks wide, 10—15 sacks high and as long as space would allow, each stack containing approximately 100 tons. Gas proof sheets of rubberised or plastic coated fabric and weighing approximately 10 ounces per one sq. yard, approximately 60′ × 40′ in size weighing about 170 lb. are used for covering the stacks. Lengths of copper tubing having an outside diameter of quarter inch are linked and joined to allow for simple jets to be disposed along the alleyways between stacks of the grain or if necessary over the top in the case of exceptionally large stacks. Two jets are provided in this case along each alleyway about 56′ long. A central gassing point is arranged for about the middle of the copper pipe line along the edge of the group of stacks containing approximately 1,000 tons. In the case of small stacks, a sing'e gas-proof sheeting is used for covering it. When very large stacks are fumigated a number of sheets are used for covering as indicated below. The separate sheets drawn up over the stacks leaving a suitable hem on the floor are joined by over-lapping five ft. with the large adjacent sheets and rolling down to the commencement of the double-fold. At each sheet junction, the same double-fold procedure is adopted. Since the rolled double-fold is not so tightly made that the rolled up material cannot be further rolled along the line of the roll, the equivalent of one very large sheet is in this way built up covering approximately 1,000 tons of grain and enclosing a space estimated up to 73,000 cu. ft. and taking 9 sheets to cover. To stop leakage under the edges of the sheeting at the base of the stack, heavy chains similar to ship's chains in length of 10 ft. to 15 ft. or 20 ft. are laid end to end round and close to the stack on top of the sheeting.

Against rodents one lb. of the fumigant for one thousand cubic feet is allowed and sheeting left in position for 12 hours although an exposure period of 6 hours may be considered adequate for the purpose. The dose required in this case, is applied from a cylinder low to the central gassing point in the copper pipe line, the cylinder being suspended on a weighing machine while the dosage is withdrawn. Since it is usual to allow for absorption of methyl bromide by the commodity fumigated at the rate of approximately 1 oz. per ton for cereal grain, the quantity of fumigant giving an effective kill of all rodents in the stacks fumigated would be remarkedly small, of the order of 15 to 20 lb. of methyl bromide.

After the period of exposure, ventilation is commenced by moving the sheeting and opening the sheeting envelope so as to encourage air currents through the alleyways or air spaces. These

carry the greatest residual quantities of gas. The period 1 to 3 hours of initial ventilation depends upon the over-all size of the sheeted pile. Small piles could be partly uncovered for one hour before removing the sheeting completely.

The sheet fumigation technique described above is also being used in England for control of insect pests, since leakage has been found considerably lower than was expected. Twenty-four hours exposure period is ordinarily used and the dosage of methyl bromide employed against insects is comparable with that employed in chamber fumigations or in barges. In this case the fumigant is applied as liquid which would issue from the jets in the form of a very fine spray. The spray vapourises at once. By means of a compressor, a pressure of 70-80 lbs. per sq. inch is first built up in the methyl bromide cylinder to ensure rapid and satisfactory application of the pre-determined amount of fumigant. The copper pipe line is cleared at the end of the application by attaching a small mobile compressor directly to the line, since extensive pipelines would otherwise retain an appreciable quantity of the fumigant.

When small undivided stacks are to be fumigated one or two rows of stacks along the top are usually lifted so that a gas dome is created and in this space the methyl bromide is released from the copper line carrying one or more jets as necessary. It is interesting to note that for the application of fumigant to 1,000 tons of grain it takes for laying the piping and jets 2½ to 3 hours for two men, for laying sheeting and chains 2½ hours for four men and for gassing half hour for two men.

Warning.—It would have to be emphasised that the operators entering space which contains harmful concentrations of methyl bromide should always wear gas masks. These gas masks should also be worn when opening up and subsequently removing the sheeting for ventilation and also when entering to test for gas before commencing to handle the fumigated cereals.

A SHORT NOTE ON THE POTATO SPRAYING OPERATIONS IN THE PLAINS OF WEST BENGAL IN THE YEAR 1950-51

By S. B. Chattopadhyaya,

Assistant Mycologist Department of Agriculture, West Bengal

As in previous years, this year also, spraying of potato against attack of early blight was undertaken in the plains of West Bengal. In the past years, this work was almost exclusively confined to the concentrated potato growing areas in Hooghly and Burdwan Districts. In the present season, spraying operations were undertaken in the districts of Midnapur, 24-Parganas, Howrah, Birbhum, Bankura, West Dinajpur and Coochbehar as well.

Altogether 450 hand sprayers (Four Oaks Kent No. 2, Four Oaks Farmers' Pattern, Kwikfil, Drenwall) were distributed throughout the State among the extensions staff (Agricultural Inspector and Union Agricultural Assistants) who undertook the spraying work in their areas. They formed one or two small units in their areas and managed the work with the help of local cultivators. The Government provided the expenses incurred in the shape of transport charges, but the actual spraying work was done by the cultivators themselves. The field staff organised and demonstrated the work and also did the actual spraying work themselves, wherever necessary. Sub-divisional Agricultural Officers supervised this aspect of Plant Protection Work.

In addition to the distribution of hand sprayers in different areas, 20 mobile centres were opened in the intensive areas under cultivation with 34 power sprayers (14 Silver Prince, 8 Hudson, 6 Richard, 3 Dobbins and 1 John Bean, 2 Huskey). The mobile unit consisted of 1-3 power sprayers which were operated by a fieldman of that section within a more or less specified area. Actual spraying work was done by the fieldstaff with the assistance of the cultivators. An active support was also lent by the extension staff who organised the work, contacted the cultivators and also helped in demonstration and propaganda. The supervision of work of mobile centres was done by officers of this section.

Altogether 18½ tons of Perenox were used up and 19,542 acres were sprayed ; 6227 acres in the districts of Hooghly, Burdwan, 24-Parganas and Midnapur with 34 power sprayers using approximately 7 tons of the chemical and 13315 acres with 372 hand sprayers in the above districts as well as in those of Bir-Bhum, Bankura and West Dinajpur, using 11 tons and 52 cwts. of the chemical.

Due to rains in the months of November, the cultivation of potato in the State was delayed till December. Consequently spraying work was undertaken from the end of December and it continued

till the end of February. Usually two sprays were applied at the rate of 4 lb. of Perenox per 100 gallons of water. One spray only was given in those cases where spraying for the second time appeared unnecessary; 0.1 per cent. water dispersible DDT was used for control of beetles. Perenox was used throughout, because it was found to be the best for the purpose.

In the season in question, potato crop had an initial set back due to late cultivation. The weather conditions were also very favourable for appearance of early blight. It was comparatively hot during day time (80°—95°F.) and the night temperature was as low as (55°—60°F), besides there were prolonged spells of wet foggy weather in the early hours of the morning. Cultivators were warned from the very beginning about the possible appearance of early blight in epidemic form. The disease appeared in different places from the middle of January in many cases, in an epidemic form, but the timely application of fungicidal spraying prevented the diseases from spreading and causing damage to the crop. It is estimated that there has been an additional yield of 7,200 tons of potato as a result of the measure, which would otherwise have been lost. The progress of the potato spraying work during the three years 1948-49, 1949-50 and 1950-51 is summarized in the table below.

TABLE I

Year	Equipments		Area of operation	Target	Achieved	Saving of loss
	Hand sprayers	Power sprayers				
				acres	acres	tons
1948-49	80	3	Serampore sub-division of Hooghly district. Memari P.S. of Burdwan Dist.	5,000	4,500	1,500
1949-50	300	21	Hooghly Dist., Burdwan Dist. partly in Midnapur and 24-Parganas Dist.	9,000	14,000	4,500
1950-51	450	34	Throughout West Bengal, Intensive work in Hooghly, Burdwan, Midnapore, Birbhum and 24-Parganas Dist.	14,000	19,542	7,200

A NOTE ON DISEASES OF WHEAT AND OTHER CROPS IN HIMACHAL PRADESH, DURING 1950-51

The following is a summarized account of the diseases of wheat, barley, maize, potato and rice which are the major crops of Himachal Pradesh.

Wheat

Rusts.—All the three rusts of wheat, black, brown and yellow occur in Himachal Pradesh. The brown rust of wheat, *Puccinia triticina,* usually appears earlier than other rusts and is common in the humid and the semi-humid areas of the State. During 1950-51, the damage due to this rust was 10 per cent. in Chamba district and 5 per cent. in Mandi. In Mahasu district there was practically no brown rust.

The yellow rust, *Puccinia glumarum,* usually appears later than the brown rust and is quite common in the hills. During the year under report it appeared in a virulent form in the Chamba and in the Churah area (3,500 ft. and over). In Mahasu district, it caused only a negligible damage.

The black rust, *Puccinia graminis,* appears last of all and is rarely destructive. In Mahasu and Sirmur districts it did not appear at all; whereas in Chamba and Mandi districts it did not cause much damage.

Bunt.—(*Tilletia caries*).—It appeared in several places in Mahasu district and caused damage to the extent of 2-3 per cent. It occurs both in the dry areas as well as in places with high summer moisture.

Loose smut.—(*Ustilago tritici*).—This smut is found generally in the humid areas of the state and attacks both the local wheat and the variety C.591 and causes a loss of about 2 per cent. The N.P. and other varieties of wheat are not affected.

Barley.—This crop was generally free from diseases except in Mandi district where it was affected by the rust and the smuts.

Maize.—No disease of maize causing any appreciable damage was noticed this year.

Potato.—The potato crop in Himachal Pradesh is subject to a number of important diseases viz., the Early blight (*Alternaria solani*), Late blight (*Phytophthora infestans*) and several virus diseases, viz., the leaf drop streak, the leaf roll, the severe mosaic and the mosaic. This year the 'Early blight' and the 'Leaf roll', appeared in a very mild form, in the 'Approved growers' fields, but caused only negligible damage (0.05 per cent.). The other diseases were not observed even as late as October.

Rice.—The rice crop in the humid areas of the State is affected by the *Fusarium* spp. During the present year the damage due to this disease was slight, about 0.5 per cent.

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THE CHEMICAL CONTROL OF INSECT PESTS*

Developments in the manufacture and use of the new organic insecticides are very rapid these days. The testing of the new chemicals is a long-time process and there is still much that we do not know about them; even those like DDT and BHC which have been in use for several years. These insecticides are poisons and must be handled as such. Quantities just enough to destroy the pests and no more should be used; otherwise the material is wasted and may become a menace to human health or to the fertility of the soil. All poisons should be kept in properly labelled tins with tightly fitting lids. On a farm where large quantities of insecticides are used, there should be a special store room for them, which can be kept securely locked. Accidents which occur with poisons are usually due to containers not being properly labelled or being left about where children have access to them. It is important that insecticides be mixed correctly, since a mixture of a poison that is too strong will injure plant growth, while if it is too weak, it will not be effective on the insects it is intended to destroy. The weights and measures used are confusing, and the only way to avoid mistakes is to use accurate measuring cups and balances and to standardize the measures as far as possible. All measuring cups, spoons and tins used for poisons should be kept in the insecticide store room and not used for anything else.

Useful weights and measures

For many purposes the four-gallon paraffin tin makes a useful measure and bucket, and this is used as a standard.

Remember in the first place that: One gallon = 4 quarts = 8 pints = 160 fluid ounces (1 pint = 20 fluid ounces). Four gallons therefore contain 640 fluid ounces. For measuring in fluid ounces, an enamel pint measure is very useful.

Two dessertspoonsful of a liquid are equivalent to one fluid ounce, and a large tea cup filled almost to the brim holds eight fluid ounces. Tea cups are usually of two sizes. The smaller tea cup filled almost to the brim, holds six fluid ounces. One fluid ounce also measures about 28½ cubic centimetres, or, to put it another way, 1,000 cubic centimetres equal 1¾ pints.

The following is an example of how to make up a spray of nicotine sulphate for aphids at a strength of one part of nicotine sulphate to 800 parts of water. In one gallon of water there are 160 fluid ounces and in 4 gallons 640 fluid ounces. For this we should need 1 × 640/800 fluid ounces of nicotine = 4/5 fluid ounce—or in dessertspoonsful 4/5 × 2 = 1-3/5 dessertspoonsful of nicotine in 4 gallons of water. To this is added 2 ounces of soap by weight.

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*Extract from an article by Dr. Bernard Smit, in Farming in South Africa, Vol. 26, No. 290, February 1951, pp. 49-51.

If other sizes of spoons are used, it must be remembered that 3 teaspoonsful of liquid fill 1 tablespoon, and that a teaspoonsful of liquid fill 1 dessertspoon. Therefore, 1½ dessertspoonsful = 1 tablespoonful.

When weights are given in pounds and ounces, there is usually no difficulty, and it is better to use weights wherever possible. However, with powders it is sometimes more convenient to measure in spoonsful.

The standard fruit-fly bait for peaches, pumpkins and marrows is made by dissolving one ounce of sodium fluosilicate and 2 lb. of sugar in 4 gallons of water.

One heaped dessertspoonful of sodium fluosilicate, heaped as high as possible without shaking, weighs just one ounce, and one pound of white sugar measures two large teacupsful.

In a large paraffin tin full of water, therefore, we use 1 dessertspoonful of sodium fluosilicate and 4 large teacupsful of white sugar.

With some powders the amount that can be heaped in a spoon varies considerably because of the fineness of the powder and its tendency to stick together and heap up. This is the case with arsenate of lead, and, to counteract this, the spoon should be knocked lightly against the side of the tin after scooping up as much of the powder as possible.

A more accurate method is to use levelled spoonsful. Fill the spoon and then scrape off the powder level with its edge, using a straight blade such as the back of a table knife. Care must be taken not to scrape away too much of the powder and leave a hollow, particularly if the powder contains hard lumps. In this way six dessertspoonsful of arsenate of lead weigh just one ounce.

For the control of caterpillars in gardens we use 2 ounces of arsenate of lead well mixed in 4 gallons of water, without sugar. This is equal to twelve level dessertspoonsful of the powder in a paraffin tin full of water.

If this method is used for sodium fluosilicate, two level tablespoonsful of the powder also weigh just one ounce.

When Paris green is used in cutworm bait, mix 5 lb. of bran with 1 lb. of sugar and 4 ounces of Paris green. In volume this is equivalent to 1⅓ gallon of bran, 2 large cups of sugar, and 8 heaped teaspoonsful or more accurately, 12 level tablespoonsful of Paris green.

One ounce of DDT "Super-spread" powder measures one heaped dessertspoonful; therefore to get 1¼ ounces of DDT 50 per cent. Super-spread powder, which is the correct amount to mix with 4 gallons of water for codling moth, take 1¼ heaped dessertspoonsful.

For one ounce of 15 per cent. Parathion wettable powder, which is the new poison for fruit-fly, take 1-1/3 heaped dessertspoonsful.

One ounce of calcium arsenate measures 2¾ heaped dessertspoonsful and similarly one ounce of benzene hexachloride powder measures one heaped dessertspoonful.

Toxaphene 40 per cent. wettable powder also measures one heaped dessertspoonful to the ounce.

Organic insecticides

DDT-Crude is insoluble in water, but dissolves in oils and paraffin.

These paraffin solutions are used for flies and other household insects, but not on plants. For plant pests use wettable powders or emulsions. DDT can also be used in the form of a fog or smoke.

DDT is very stable and has a long-time residual effect. It is very toxic to flies, many beetles (including Lady-bird beetles), many plant sucking bugs, bedbugs and many caterpillars. It is not effective against locusts. It is harmful to plants belonging to the cucumber family.

DDT must not be mixed with lime or alkaline materials.

Benzene Hexachloride is also insoluble in water and is therefore used as dust or in the form of wettable powders and as fogs and smokes. It has more rapid "knock-down" action than DDT.

It does not have the same residual effect as DDT, but may remain active in the soil for many months. Its eventual effect on soils is not known.

It has a strong musty smell and may taint vegetables and fruits if incorrectly applied.

It is toxic to locusts and many other insects and is often mixed with DDT because the properties of the two substances complement each other.

Parathion (Thiophos) is very toxic to most insects, especially mealybugs and aphids and to red spider. It has a fumigating as well as a contact action. It may be used in the form of a dust or as a wettable powder in water. It loses its toxicity in about two weeks.

Parathion kills almost all insects, including beneficial species, and is very poisonous to human beings and higher animals, with a cumulative effect which may cause sudden collapse.

Toxaphene (Chlorinated Camphene).—This is a cream-coloured waxy solid which is soluble in the common organic solvents and can be formulated in oil-soluble concentrates, water suspensions and as a dust.

It has some residual action. On the whole it is not as effective as DDT but against some agricultural pests its use is preferred.

In America, it is now being largely used against cotton insects.

Pestox is a new systemic insecticide used as a concentrated spray.

It is absorbed by the plant and carried to all parts in the sap. Sucking insects such as aphids feeding on such plants are killed and the plants are said to be immune to attack for three weeks.

The material is very toxic to human beings and can only be handled by experienced operators.

Useful formulae

The following insecticide formulae are given for easy reference.

The tendency is to use more dry dusting powders than wet sprays on low-growing plants, such as vegetables. In such cases the powders are usually bought ready to use and should be applied with a good dusting machine.

Cover Sprays For Leaf-feeding Insects

(*Stir thoroughly* !)

(1) Arsenate of Lead : 2 ozs., Water : 4 gallon.

(2) DDT 50 per cent. superspread : 1¼ ozs. or 2 lb., Water : 4 gallon or 100 gallon.

(3) Calcium arsenate : 3 ozs., Slaked lime : 6 ozs., Water : 4 gallon.

(4) Derris or cube root 5 per cent. powder : 2 ozs., Water : 4 gallon.

(5) Cryolite : 1 oz., Water : 4 gallon.

(6) Paris green : ½ oz., Slaked lime : 1 oz., Water : 4 gallon.

Do not use lime with cryolite or sodium fluosilicate.

Dusts For Leaf-feeding Insects

(1) Arsenite of lead. Pure, fine powder.

(2) Calcium arsenate dusting powder : 1 lb., Slaked lime fine, sifted : 2 lb.

(3) Paris green : 1 lb., Slaked lime : 10 lb.

(4) Cryolite : 1 lb. Talc : 1 lb.

(5) Sodium fluosilicate (fine powder) : 1 lb., Clay, fine, sifted : 5 lb.

(6) DDT : 5 or 10 per cent dust.

(7) Toxaphene : 10 per cent or 20 per cent dust.

(8) Benzene Hexachloride : 2 per cent or 5 per cent dust.

Contact Sprays for Sucking Insects

(1) Oil sprays : 1 or 2 per cent in water (1 part to 100 or 1 part to 50 parts of water).

(2) Nicotine sulphate : 1 fluid ounce, Oil spray : 12 fluid ounces, Water : 4 gallon 2 ounces of soap can be used instead of the oil spray.

(3) Lime-sulphur : 1 part to 20 parts of water in winter and 1 part to 80 parts in summer.

(4) Pyrethrum extract : 1 fluid ounce, Water : 4 gallon.

(5) Parathion 15 per cent. wettable powder : 2 ounces, Water : 4 gallon.

(6) Soap (mild yellow soap) : ½ lb. Water : 4 gallon. Cut soap into small pieces and boil to dissolve in one gallon of the water. Then add 3 gallons of cold water and mix.

Dusts for Sucking Insects

(1) Nicotine Dust (2 or 4 per cent). To make 2 per cent dust, thoroughly mix 1 quart of 40 per cent. nicotine sulphate with 50 lb. of finely sifted slaked lime.

(2) Pyrethrum dust.

(3) B.H.C. "Bexadust".

(4) Parathion : 1 or 2 per cent dust.

(5) Toxaphene : 10 or 20 per cent dust.

(6) Sulphur : special dusting.

(7) DDT : 5 per cent dust.

Baits Which Attract and Poison Insects

(1) Fruit-fly Bait.

Sodium fluosilicate : 1 oz. or

Parathion (thiophos) : 15 per cent wettable powder, 1 oz.

White sugar : 2 lb.

Water : 4 gallon.

(2) Cutworm, lawn caterpillar and cricket bait.

Calcium arsenate : 6 ozs.

or

Paris green : 4 ozs.

or

Sodium fluosilicate : 4 ozs.

Sugar : 1 lb.

Wheat bran : 5 lb.

Mix dry and dampen to make a stiff mash.

(3) Locust and Grasshopper Bait.

10 per cent. Benzene hexachloride : 4 ozs.

Sugar : 1 lb.

Bran : 5 lb.

Mix dry and dampen to make a stiff mash.

(4) Cedara Cutworm Bait.

Sodium fluoride : 6½ ozs.

Water : 2 gallons in a 4 gallon paraffin tin.

Add 2 gallons chopped prickly pear pieces 1 inch square, stir and soak overnight.

(5) Green Cutworm Bait.

Arsenite of soda, calcium arsenate or other arsenical poison : 1 lb.

Sugar : 8 lb.

Water : 8 gallons.

Stir well and mix this with chopped green stuff such as barley or beet tops to make a damp mash.

(6) Harvester-Termite Bait.

Sodium arsenite (locust poison) : 1 lb.

Water : 8 gallons.

Cut dry veld grass into half-inch lengths and dip this into the above solution until thoroughly wetted with it. Drain and dry the bait in the sun before use. Sodium fluosilicate can be used instead of sodium arsenate and is less dangerous to stock;

(7) Termite Pump Powder.

White arsenic powder : 3 lb.

Flowers of sulphur : 1 lb.

Mix dry powders thoroughly and use in pump brazier.

Snail and Slug Bait.

(8) (a) Metaldehyde : 1/2 oz. or Meta fuel : 3 tablets.

Wheaten bran or mealie-meal : 1 lb.

Water to make a stiff mash.

(b) Calcium arsenate : 1 lb.

Bran : 12 lb.

Well mixed and damped with water to make a stiff mash.

(9) Ant Poison.

Tartaric acid : ¼ oz.

Benzoate of soda : ¼ oz.

Sugar : 12 lb.

Water : 10 pints.

Boil and stir to dissolve. Dissolve 3/4 oz. of pure arsenite of soda in one pint of hot water and add to the above and stir again.

or

(10) Mix 8 lb. of golden syrup with 4 pints of hot water. Dissolve 20 grams (4 level teaspoonsful) of arsenite of soda in one pint of hot water and add this to the syrup. Add water to make one gallon and stir well.

REPORT AND RECOMMENDATIONS OF THE INTERNATIONAL CONFERENCE ON CONTROL OF DESERT LOCUST HELD AT ROME IN OCTOBER 1951 UNDER THE AUSPICES OF THE FOOD & AGRICULTURE ORGANISATION

Desert Locust Situation and Outlook

1. The Conference surveyed the general Desert Locust situation and noted that, as a result of unfavourable breeding conditions in some area and of the successful national anti-locust campaigns, serious infestation by October, 1951 became restricted to south-western Arabia and north-eastern Africa, while most other countries were either free of swarms, or the infestation was not on a serious scale.

2. The Conference considered that the present reduction in the extent of the plague offered a hope of achieving a decisive success by concentrating control efforts in the more heavily infested areas.

3. Special efforts to reduce the plague will be required during the period November, 1951 to March, 1952 in all countries of the Arabian peninsula, in the British and French Somaliland, Somalia, Ethiopia, Eritrea and the Sudan, as well as in Iran and Pakistan, and possibly Kenya and Tanganyika.

4. Should the winter-spring campaigns be unsuccessful or incomplete, a recrudescence of the plague and its further spread may be expected and further extensive campaigns to protect crops will then become necessary in summer breeding areas.

Present National Organisation of Control Operations

5. The Conference reviewed the plans submitted by the delegations of the various countries and considered them to be generally adequate to meet the present situation.

6. The Conference noted with satisfaction that many countries were fully equipped for carrying out their plans while for some others reinforcements from outside sources will be necessary to ensure the success of the campaign as a whole.

7. The Conference has reviewed in Committee the resources in equipment and supplies of the countries concerned and the immediate needs for ensuring the success of the campaign in 1952. The Conference adopted the report of this Committee (Appendix) and drew special attention to

(a) the need for the provision of equipment and materials to the value of £251,800 for immediate distribution to those territories requiring additional assistance.

(b) the need for the provision of similar equipment and materials to the value of £161,200 to be held in a strategic pool.

(c) the establishment of a pool of twenty-five light aircraft which could be made available to different countries affected by the Desert Locust Plague. The cost of setting up and maintaining such a pool was estimated at £140,000.

(d) arrangements for the procurement and allocation of these materials and equipment should be the responsibility of the FAO with the advice of the Standing Technical Advisory Committee referred to in paragraph 10 below.

8. The Conference supports the request of the Desert Locust Control for financial aid and recommends that the FAO should explore the possibility of securing financial assistance to ease the heavy costs that are now being met by certain anti-locust organizations that operate in foreign territories for the common good.

9. The Conference recognizes the value of the co-ordination of the anti-locust work that already exists in the eastern and central regions of the Desert Locust area, and is pleased to record that similar regional co-ordination is being established in the western region and hopes that FAO will assist in the regular functioning and strengthening of the regional organization.

10. The Conference considered that overall success in the anti-locust campaigns can only be achieved by general co-ordination of plans and efforts throughout the whole Desert Locust area.

Such general co-ordination can best be achieved through the agency of the Food and Agriculture Organization of the United Nations, and the conference requests that Organization to accept this responsibility and to take the necessary action.

11. (i) The Conference hopes that the Director-General of the Food and Agriculture Organization will establish a Standing Technical Advisory Committee on Desert Locust Control, composed of locust experts of the highest technical standing nominated by the Government of Egypt, France, India, Iran, Pakistan, the United Kingdom and the United States of America, with the Director of the Anti-Locust Research Centre, London, as Consultant to the Committee.

(ii) The Committee should be enabled to invite any other Government to send technical representatives or consultants, as required, to participate in its work.

(iii) The Committee should have the following functions :—

(a) to advise FAO on the desert locust situation and the measures necessary to keep it under control ;

(b) to establish uniform procedure for the preparation and presentation of reports on locust control by the countries concerned ;

(c) to assess the overall requirements of equipment and supplies needed to implement plans for campaigns, and to consider and advise FAO with regard to any request

for assistance that may be required to supplement national efforts in the general interest;

(d) to provide advice and assistance in the procurement of equipment and supplies;

(e) to make recommendations on the distribution on movement of equipment and supplies provided from outside sources.

(iv) The Committee should meet whenever required at such places as may be appropriate.

12. The Conference requests the Director-General to consider calling general conferences on desert locust control on the advice of the Standing Technical Advisory Committee.

13. The Conference records its appreciation of the initiative taken by the FAO in calling this Conference which it is felt is a valuable contribution towards strengthening the co-ordination that is essential for the efficient conduct of the international campaign against the Desert Locust.

REPORT ON THE PRELIMINARY TRIALS OF DIATOMITE SAMPLES

Diatomite samples were supplied to the Government of India by M/s Dalgety and Co., Ltd., Nairobi through the Commissioner for the Government of India in British East Africa, Nairobi. The samples supplied were G 5 (0.5 per cent Gamma BHC), DDT (1 per cent), DDT (5 per cent), Pysil (25 per cent pyrethrum) and Pyroxane (25 per cent pyrethrum : 10 per cent Gamma BHC). All these formulations were in Kensil diatomite carrier.

Samples of Diatomite insecticides were tried during last winter and spring against *Empoasca devastans* infesting brinjal and lady's finger ; *Bemisia tabaci* on brinjal and tomato ; *Aphis gossypii* and *Urentius echinus* on brinjal ; *Diaphorina citri* on citrus and *Aulacophora foveicollis* damaging cucurbitaceous crops.

Trials with 1 per cent DDT dust against *Empoasca devastans, Bemisia tabaci and Aphis gossypii* gave 50 per cent kill of the former but proved ineffective against the latter two pests ; those with 5 per cent DDT against *Bemisia tabaci* gave 95 per cent kill of the pest. Sample G 5 containing 0.5 per cent Gamma BHC gave 80 per cent kill of *Urentinus echinus* and 75 per cent of *Aphis gossypii.* Pysil used in concentration of 1.0 per cent pyrethrum gave a kill of 50, 55 and 73 per cent of *Empoasca devastans, Diaphorina citri* and *Aulacophora foveicollis* respectively. Whereas Pyroxane in concentration of 1.0 per cent pyrethrum and 0.4 per cent Gamma BHC gave 72, 62 and 76 per cent kill of the pests in the order mentioned above. The diluent used was talc grade 4 in both Pysil and Pyroxane.

Both the samples Kensil Roil and Pyroxane are being tried as inert dusts against stored grain pests. Report on these tests will be published later.

PRACTICAL RESULTS ACHIEVED IN THE DDT AND BHC SCHEME FOR THE CONTROL OF PESTS IN MADRAS STATE

Of the remarkable advancements made in Science during the recent war, the discovery of the insecticidal properties of DDT and its further developments constitute a land mark in the history of medical Entomology for the protection of mankind against certain dire diseases transmitted by insects. A three year Scheme (1946-49) was kindly sponsored by the Indian Council of Agricultural Research to test the adaptability of this chemical along with that of BHC for the protection of crops against their insect enemies. The present note furnishes a short account of the work done and the results obtained.

Ready made commercial formulations of the insecticides were not easily available during the earlier years of the Scheme and the experiments had, therefore, to be conducted with small quantities of the purer forms obtained from some of the firms. These were later ground and hand-mixed with the available diluents and used The results, though indicative of the lethal action, were not quite conclusive. Machine-ground, commercial preparations at the required concentrations were, however, available during the later period of the scheme. These were promptly pressed into service and the results were, on the whole, more convincing. Another handicap which had to be encountered, was the phenomenal failure of the monsoons successively for all the three years, as a result of which the growth and yield of the crops were at no time normal.

A short resume of the pests tackled within the limits of the Scheme is furnished below :—

The Sorghum ear bug (*Calocoris angustatus*).—This is an active green insect occurring in large numbers on the ears. Stray adults appear when the flower heads emerge but the population multiplies so rapidly and that too within such an incredibly short period that the ears literally teem with hundreds of the nymphs and adults by the time the ears reach the milk stage. The period of infestation itself is restricted to two or three weeks, commencing from the time of flowering upto the time when the grains set. The bugs suck and feed on the nutrient material and the drain of the sap is so severe during certain years that it weakens the setting of the grains, often rendering the whole ear chaffy. Appreciable population may also be found even after the grains have set and developed but very little damage is effected at that time. The pest is particularly severe on the irrigated Sorghum (April to June) at Coimbatore and on the dry crop at Guntur raised during June to September. Previous experience at Coimbatore has indicated that the incidence is influenced to a large measure, by the time of sowing, the earlier sown crops being able to ward off the damage by the pest, which would come after milky stage of the ears.

Different concentrations of DDT and BHC dusts ranging from 2 to 5 per cent were tried, both on a small as well as on a large scale.

An appreciable reduction in the pest population was recorded as a result of the treatments in most of the experiments. The yield data, though indicative, were somewhat erratic, as the percentage of increase in the yield ranged from 1.87 to 156.5 over the controls, which can be attributed more to the unfavourable seasonal conditions. More important than the actual yield data, the experiments amply indicated the very high insecticidal properties of the chemicals. BHC dust in all its concentrations (2 per cent to 5 per cent) was found to cause a quick knockdown while DDT was somewhat slow. BHC besides its higher efficacy is cheaper in cost. The standard formulation at 5 per cent was given a further trial during subsequent years after the closure of the scheme and its efficacy established beyond doubt. It is, therefore, being advocated as an approved measure of control at the rate of 20-25 lbs. of dust, costing Rs. 5 per acre.

The Chillies Thrips (*Scirtothrips dorsalis*).—These are minute insects, yellow in colour with fringed wings. They occur in large numbers on the tender shoots and flowers of the plant, lacerate the tissues and suck up the sap. The damage is evinced by the curling of the leaves and stunted growth and eventually even the death of the plants. Similar concentrations (2 per cent to 5 per cent) of the chemicals as used against the ear bug were dusted and the results compared with those of tobacco dust which has been advocated till recently. Here again, the action of BHC was specific and the mortality quicker. The additional yield ranged from 1.95 to 71 per cent over the control in the treated plots. The use of this chemical has now passed the experimental stage and is being rapidly popularised. The approximate quantity of the chemical required to treat an acre may be about 20 lbs. costing about Rs. 5.

The Rice thrips (*Thrips oryzae*).—These are active creatures usually found inside the rolled up tips of the tender leaves. These insects also lacerate the plants tissue, suck up the sap and cause the withering of leaves. The pest occurs commonly in the nurseries and is particularly severe during season of drought. Ordinarily a timely shower eliminated the pest, in the absence of which a good drench with tobacco decoction (1 : 6) was resorted to. Aqueous concentrations of BHC and DDT ranging from 0.05 to 0.25 per cent were sprayed and the reduction in the population noted. Again BHC spray even at a low concentration was found to produce the desired results and was superior to tobacco decoction. The prabable requirements of the spray fluid (0.1 per cent) would be 100 gallons per acre costing about Rs. 6.

The Brinjal ladu bird beetle.—(*Epilachna* sp.).—This is a major pest of brinjal all over the State. The adults are hemispherical in shape and pale red with characteristic black spots. The grubs are fleshy, yellow in colour with spiny proturberances. Both the adults and grubs scrape and feed on the green matter of the leaves, causing appreciable damage. Various concentrations of the two insecticides

ranging from 3 to 5 per cent as dusts and 0.05 per cent to 0.25 per cent as sprays were tried and the results compared with those of calcium arsenate, which has been in vogue till now. It is curious to note that BHC had hardly any effect against this insect. DDT had a specific lethal action, comparable to that of calcium arsenate, but its application invariably brought about a heavy infestation of mites.

Though the investigations were restricted to the control of the above mentioned four species, the experience gained during the course of these trials was really an eye-opener regarding the potentialities of those chemicals. The experiments were subsequently extended against a variety of other crop pests. The results were so convincing that the chemical mode of warfare is fast replacing the laborious and cumbersome mechanical methods of control advocated till recently. The Plant Protection Organization of the State is actively sponsoring the use of these insecticides against a wide range of crop pests and a list of the results as extracted from their reports is furnished in the statement appended. A phenomenal demand has been created for the two chemicals and they are now freely available both in dust and wettable forms at competitive rates with a number of firms.

A few pecularities regarding the action of these chemicals as experienced at Coimbatore, are also worth mentioning here. Of the two, BHC either as spray or dust is highly efficacious against most of the external feeders, generally as a lethal agent and sometimes as a deterrent as well. Its action is perceptibly quicker. DDT, on the other hand, is slower in action but is an infallible remedy against certain groups of insects like Jassids. Despite the remarkable adaptability of these synthetic products for plant protection purposes, they have to be used with care since their application is often fraught with certain adverse effects as well. The more common example is the heavy infestation of mites and sometimes of aphids, which invariably follows the application of DDT on most crops, susceptible to these pests. This phenomenon can be attributed only to the selective action of DDT, which, while being comparatively inert against these pests, is highly fatal to the parasites and predators which exert a natural check on these pests. Again the chemicals also have a phytocidal action. Plants belonging to the order Cucurbitaceae like cucumber, bottle, bitter and snake gourds etc., as well as a few other species are highly sensitive to BHC as most of them wilt away after one or two applications. DDT also has similar undesirable qualities but the deleterious effects are slower. A more serious aspect is that the chemicals are likely to impart a trace of their peculiar odour to edible material like fruits, vegetables etc. The usual precaution observed in such cases is to stop their application a month prior to harvest. The absorption of these poisonous compounds by the plant tissues and the possible adverse effects on man and other higher animals consuming these are perhaps some of the major issues, on which there is considerable divergence of opinion.

A list of various insects against which the insecticides were found effective is appended below :—

Name of pests	Crops	Insecticides found effective for control
1. The Rice Grasshopper (*Hieroglyphus banian*)	Paddy ..	BHC (Gammexane—5% —D.025) dust.
2. Paddy Small Grasshopper (*Ozya veloz*) ..	Paddy ..	BH Do.
3. The paddy jassid (*Nephotettix bipunctatus*)	Paddy ..	DDT dust and spray 1·0%
4. Rice bug (*Leptocorisa acuta*)	Paddy ..	DDT and BHC dust 5%
5. Striped bug of paddy (*Tetroda histeroides*) ..	Paddy ..	5 to 10% BHC dust.
6. Swarming caterpillar (*Spodoptera mauritia*)	Paddy ..	5% BHC (D.025 Gammexane) Dust.
7. *Leptispa pygmoea*	Paddy ..	DDT and BHC dust 5%
8. *Hieroglyphus nigrorepletus*	Millets ..	BHC (Gammexane D.025) 5% Dust.
9. Deccan Wingless Grasshopper (*Colemania sphenarioides*).	Millet ..	BHC 7%—10%
10. The betel vine bug (*Disphinctus politus*) ..	Betel in vine	DDT dust 5% BHC spray ·05%.
11. The grape vine beetle (*Sceledonta strigicollis*)	Grape vine ..	BHC spray 0·1%.
12. Jassids (*Empoasca devastans*)	Cotton, brinjal, Bhindi.	5% DDT dust & ·1% spray.
13. Surface Grasshoppers (*Chrotogonus* sp. and *Aeolopus* sp.).	Low growing crops.	BHC (Gammexane D.025) dust 5% or 5% Hexyclan.
14. Thrips	Cumbu ..	Dust BHC 5% (Gammexane D.025).
15. Agathi weevil (*Alcides bubo*)	Agathi ..	BHC spray 0·1%.
16. Lablab bug (*Coptosoma cribaria*)	Lablab ..	5% Dust BHC (Gammexane D.025).
17. Mango hopper (*Idiocerus* spp.)	Mango ..	DDT 5% dust (BHC ineffective).
18. Onion thrips (*Thrips tabaci*)	Onion ..	BHC spray ·05—·1%.
19. Sugarcane leaf hopper (*Pyrilla* sp.) ..	Sugarcane ..	5% BHC (D.025 Gammexane).
20. *Hieroglyphus banian*	Sugarcane ..	Do.
21. Red hairy caterpillar (*Amsacta albistriga*) ..	Ground-nut	BHC 0·1% spray 5% BHC (D.025 Gammexane) dust.
22. Termites and red and black ants ..	..	BHC and DDT 5%.

SYSTEMIC INSECTICIDES

Of the various systemic insecticides so far examined bis (bis dimethylamino phosphorous) anhydride, known to U.S. workers as octamethylpyrophosphoramide, has proved the most promising and is today the most widely explored. Bis (bis dimethylamino phosphorous) anhydride has been introduced in U.K. under the trade name of Pestox 3. It is a liquid soluble in water and formulated to contain 60 per cent. active ingredient. It is absorbed by the leaves from both surfaces and then, by travelling in the sap stream is translocated to other parts of the plant (a cabbage leaf, painted in stripes with Pestox 3) became toxic in every spot. The translocation so far measured occurred on Brassica, where after spraying the leaves the flower head was found to be toxic.

One of the greatest advantages of Pestox 3 and other systemic over the old type insecticides is their translocation to the growing point of the plant, because that new growth which was not in existence at the time of spraying is rendered toxic to the pests. When applied to the soil around a plant Pestox 3 is taken up by the roots and is translocated to the foliage. Thus we find translocation of systemic insecticide within the leaf, from leaf to leaf, from leaf to flower head, from seed to young plant and from the roots to the vegetative organs. The period over which the plant retains its toxicity depends upon the time of the year and the physiological activity of the plant. During summer, when the plant is growing actively, toxicity disappears in three weeks, but after an application in late autumn, toxicity in strawberry plant was observed four months later. Experiments on a large variety of plants, also large scale application on agricultural crops, have shown that Pestox 3 renders plants toxic to a wide range of aphids and red spider. California investigators found also that it has a repellent effect on scale crawlers when applied to citrus. The rapidity at which Pestox 3 renders plants toxic to aphids is in positive correlation with the concentration sprayed.

There is limited contact effect against aphids but against many other insects this does not exist. Pestox 3 is transformed in the plant into a Cholinesterase inhibiting compound which is inaccessible to parasitic and predacious insects. The selective characteristic of Pestox 3 is important because insects that escape it fall prey to predators. Thus by using Pestox 3, it is possible to combine the advantages of chemical control with those of the natural biological control. Again volume of spray is of no importance since all the quantity is absorbed by the plant and redistributed in the system.

Pestox 3 is distinctly toxic to mammals. Greatest care is therefore necessary both in handling of Pestox 3 and the timing of spraying and harvesting of sprayed crops. Since decomposition of Pestox 3 in the active plant produces a nil residue four weeks after spraying, all danger to the consumer is avoided if a six weeks interval is allowed to elapse between spraying and harvesting. Operators must be suitably protected. With Pestox 3 the field can be entered after 24 hours without any danger but that is not so with parathion, etc.

Virus also is prevented because Pestox 3 protects the plant against virus.

A further contribution to the killing of pests on crops and flowers which consist of a far less toxic systemic insecticide capable of use even by the layman on the roots of his roses, or the glasshouse horticulturist on lettuce or spinach, was recently announced by Pest Control Limited.

Discovered in the chemical research laboratories at Harston by Dr. G. S. Hartley and styled Isopestox, it is chemically bis isopropylaminofluorophosphine oxide. The pure chemical is a solid, melting at 60°C. and is very hygroscopic. It is made up into a solution containing 5 per cent Isopestox. It is not volatile, does not smell, and is not corrosive. In the commercial formulation a warning colour, methyl violet, is added. Its oral toxicity to rabbits and guinee pigs is low : it is 26 times less toxic than Parathion, 9 times less toxic than nicotine, and little more than twice as toxic as DDT. It is claimed that it will greatly facilitate lettuce growing because being systemic, it can reach the aphids after the heads of the lettuce have formed.

Its use is thought to lie in treatment of crops infested with thrips, white fly larvae, or mealybugs ; and in the treatment of crops nearer to harvest time, when the application of a more toxic insecticide would not be possible because there would not be a clear period of four to six weeks between spraying and harvesting.

It is thought to be of special use for late outbreaks of aphids or red spider on hops, and for treating cabbage aphis on brussels sprouts later in the year.

SHORT NOTES AND NEWS

Wheat Rust *

An emergency research programme to meet a threat to North American wheat production from a 'new' race of stem-rust fungus, has been summarized by H. A. Rodenhiser and E. G. Moore, of the Agricultural Research Administration, the U.S. Department of Agriculture.

The fungus, described as race 15-B has been known since 1939 to exist on wild barberry plants. It was first encountered on wheat plants last summer, when it appeared without warning over a wide area from Texas to Manitoba. In the United States, it caused the loss of one-fifth of the total crop of 'hard' wheat, although most varieties had already matured before the outbreak reached its peak.

In explanation of the general relationship between rust-strains, barberries and wheat, it is recalled that while plant-breeders are hybridizing wheat to produce resistant strains, strains of the fungus hybridize under natural conditions while living on barberries, so that new races develop which only later are found on wheat.

Control of Potato Moth†

Ferric oxide with 0.1 per cent. DDT gives complete protection to the tubers. Field tests showed that DDT sprays and dusts provide a practical method of controlling moth attack on growing crop.

Plant Fumigated by Magnetic Attraction‡

A new development in dusting plants with fungicides and insecticides will be tested commercially this summer in the United States. The dusts are electrically charged and by electro-magnetic attraction attach themselves to the leaves of plants much more efficiently than in ordinary dusting.

In the new process, reported from East Lancing, Michigan, fine dust particles are charged with from 12,000 to 20,000 volts as they emerge from the nozzle of a regular commercial dusting machine. The high charge is held for several seconds—sufficient to last while the dust travels a long distance.

TCA Gaining in Importance as a Weedy Grass Killer§

TCA (Sodium salt of trichloroacetic acid) has not only proved itself in the control of many perennial weedy grasses in extensive field trials, but also is showing promise in killing annual grasses in certain

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*Extract from Science Newsletter, No. 30, 15th June, 1951, p. 7, issued by the Scientific Adviser, India House, London.

†Extract from Science Newsletter, No. 33, p. 7, issued by the Scientific Adviser, India House, London.

‡Extract from Science Newsletter, No. 30, 13th July, 1951, p. 8, issued by the Scientific Adviser, India House, London.

§Extract from Agricultural News Letter (cf. E. I. Du Pont De Nemours & Co.), Vol. 19, No. 3, May-June, 1951, p. 42.

TCA-tolerant crops, such as sugar beets and table beets, flax, and established alfalfa. TCA is expected to become one of the farmers' most dependable killers of grass weeds such as quackgrass, Johnson grass and Bermuda grass. TCA does its damage as it comes in contact with perennial weed roots. Contact with above-ground foliage has little effect on the weed, as the poison is not transferred from the foliage to the roots. Much of TCA's success, therefore, depends on leaching of the chemical down through the soil to root level. This means the poison should be applied at a time of year when soil moisture conditions or rainfall can be counted on to leach it. Used as an annual weed killer, TCA has been found to control seedlings of green and yellow foxtail (Setaria species), barnyard grass (Echinochloa species) and panic grass (annual Panicum species), without damaging sugar beets and table beets. TCA was applied as a pre-emergence treatment. Pre-emergence treatment also controlled Setaria in flax and alfalfa without damage to the crop.

Pest Control by Bacteria*

A Spore-forming bacterium—*Bacillus thuringiensis* Berliner—successfully reduced populations of the alfalfa caterpillar to below the economic level in field tests. The bacillus is produced easily in large quantities stored in powder form, and applied to infested fields by any sprayer used for the application of insecticides. The bacterium acts relatively fast, killing the pest within two days, and leaves the alfalfa clean. The fact that the bacillus is pathogenic for some insects under certain conditions and that it retains its virulence when cultivated repeatedly on artificial media or when stored in a dried condition makes it an inviting organism with which to work, especially since it is a potential control agent not only against the alfalfa caterpillar but against certain other insects as well.

A new Coconut Pest in Singapore†

Mr. R. J. A. W. Lever has recently referred to the occurrence of the Philippine leaf beetle, *Promecotheca cumingi* Baly, in Singapore. He says that this beetle was introduced into Singapore probably by air on plant material from Philippines in 1949, and when first noticed in April 1951 was attacking coconuts in the South-east portion of the Island. Its spread appeared to be checked by August and it is hoped that the indigenous larval parasite *Pleurotropis parvulus* Ferr. will continue to keep it under control, as insecticidal treatment would be both difficult and expensive. (This pest is not found in India. There is grave danger of this beetle entering India also with plant material imported by air from Singapore. Adequate care has, therefore, to be taken to prevent its entry).

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*Extract from an article by Edward A. Steinhaus in California Agriculture 5 (6), 5.

†Extract from Malayan Agricultural Journal, Vol. XXXIV, (2) : 79-82, 1951.

Vine Mites**

Control of vine mites is suggested by use of strong lime sulphur, strength 1 in 9, just before bud-burst, followed by 2 lb. colloidal sulphur in 100 gallons of water when growth is 8 to 12 inches long. This latter spray should be mixed with Bordeaux if it is required. The strong lime-sulphur spray will also control erinose, a condition in vines caused by a tiny mite which results in raised lumps on the leaves which are hairy underneath.

Slugs and Snails on Citrus**

Baiting is the best method of control of these pests. The bait consists of a mixture consisting of 16 lb. bran and 1 lb. calcium arsenate mixture should be moistened to a crumbly consistency. Chopped orange pulp makes the mixture more attractive to these pests. The bait should be distributed around the trees during warm evenings in the spring.

Root Borer in Deciduous Trees**

The effect of root borer on deciduous trees can be detected by the stoppage of shoot growth, small unhealthy leaves and die-back from the tips of leaders, with eventual death of the affected limbs. The growth of fairly strong shoots from low down in the tree also seems to be a characteristic of this condition. Trees affected with root borer may sometimes be confused with trees suffering from water-logging or zinc deficiency. However, the greyish snouted beetles which will be seen climbing infested trees confirm the cause of the trouble. Root examination of severely-affected trees will reveal the typical channelling of roots.

Crinoline fly-wire traps attached to the trunks and sprayed with DDT will act as a barrier to the beetles. Regular examination of the traps, say every two days on a dozen trees in an affected patch, will indicate the numbers of beetle emerging. When the beetles are being caught, the whole of the area should be sprayed with DDT, strength, 0.1 per cent. This spray is effective against adult beetle and small larvae hatching from the eggs which are laid in clusters on the leaves.

In addition to spraying, regular applications of 5 lb. per tree 2 : 2 : 1 "complete" fertilizer in the spring will help affected trees to recover. Because of the long life of borer grubs underground, extending upto seven years, it is necessary for controls to be continued for several years before any marked recovery can be expected.

A New Nebulizer for the Orchard*

Although immediately after the war atomizers, aerosols, fumigators, speed-sprayers and other equipment were applied to speed up the work involved in the control of diseases and pests, the Netherlands is

**Extract from Journal of Agriculture, Victoria, Australia, 49(9) : 455-456, 1951.
*Extract from Agricultural Newsletter from the Netherlands, No. 3, 1951.

most probably the first country where a nebulizer has been used for routine sprayings of fungicides, bactericides and insecticides. This nebulizer is suitable for spraying numerous crop protecting products at the tenfold of the usual concentrations. This not only leads to appreciable savings of sprays and in transport costs but also of labour as the work can be accomplished much quicker. Without causing any damage to fruit trees even sprays containing 60 per cent. of tar oils were applied in winter. As no spray drips from the trees less liquid is needed and results in saving on washes.

Color-set 1004*

This is a promising new pre-harvest drop control product offered to food growers in the U.S.A. The product contains a salt of a-(2,4,5-Trichloro-phenoxy) propionic Acid (TCPPA) as the active ingredient. It not only gives better control of drop but also the period of effectiveness from one application is considerably longer.

The chemical takes somewhat longer period to become effective, and, therefore, has to be applied at least 5-8 days before dropping is expected to start. On many apple varieties it may be counted upon to remain effective for at least 3 weeks and in some cases four weeks or longer. It has been found in many areas where peach harvesting normally interferes with proper timing of preharvest drop spraying and obviously where timing is not a critical factor it simplifies preharvest drop control everywhere. Its possibilities in enhancing colour formation and marketing quality of fruits are under intensive investigation. A 20 ppm. spray concentration is believed to be about right for most apple varieties for preharvest drop control. Not more than two applications should be used. This chemical should not be used for chemical thinning.

Systemic Fungicide†

A range of preparations based on phenyl mercuric dinaphthylmethane di sulphonate recently marketed by Ward, Benkinsop & Co., Ltd. (6 Henrietta Street, London, W.1) were known to have a higher activity against bacteria and fungi than the older mercuric compounds, to be less toxic and to have the advantage of retaining their activity in the presence of organic matter. Under the brand names Penotrane, Fibrotan and Septotan the preparations were offered for medical uses, such as the treatment of skin infections, for agricultural uses including fungicidal seed dressings and horticultural sprays, and for industrial uses such as the proofing of wool, furs, hides, leathers, cellulosic textiles, timber and wood pulp against mould and fungal attack. (Manufacturing Chemist, May 1951, p. 182-5).

New Insecticide Promising in War against Corn Borer‡

A new organic phosphorous insecticide tested by the Illinois Natural History Survey, working in co-operation with Illinois canners, has proved effective for control of the European corn borer.

*Extract from Down to Earth, Vol. 7, No. 1, Summer, 1951, p. 2.

†Extract copy from Science News Letter, No. 41, No 847, p.4 issued by the Scientific Adviser, India House, London.

‡Extract from Agricultural News Letter, Vol. 19, No. 3, May-June, 1951, p. 68.

The new weapon against the borers, EPN-300 insecticide, developed through Du Pont research work, was tested during 1950 and showed considerable promise. It was reported for example, to give an average of twice the residual protection of one of the newer organic phosphates in use for controlling the corn borer during the past two years. The tests were conducted under the supervision of William H. Luckmann, of Illinois Natural History Survey.

Good results were obtained from both dusts and sprays containing the new material. As a dust a 2 per cent EPN mixture applied at 30 pounds per acre proved one of the most outstanding treatments. Because the material is highly dispersible, a low-gallonage application of spray material was possible, with 1.8 pounds of EPN-300, equal to approximately a half pound of the active ingredient, in 28 gallons of water applied per acre. A low gallonage sprayer with all screens removed, delivering from 40 to 80 pounds pressure, was used.

Allethrin—A Substitute for Pyrethrum*

Carbide and Carbon Chemical Co. of the U.S.A. have announced that they will build a six million dollar plant for the manufacture of allethrin—a substitute for pyrethrum. The new set-up for making the synthetic products promises to end the uncertainty of supply and fluctuating prices of pyrethrum. The company's officials state that the allethrin produced at the new plant will cost less than natural pyrethrins. Its toxicity had already been fairly well-established at roughly the same low level as natural pyrethins—an important consideration at a time when the public is superconscious of toxic residues on food.

Bacterial Ring Rot†

Methods of disinfecting or fumigating used potato bags to destroy the bacterial ring rot organism have been studied with a view to finding a method that second-hand bag dealers would find practical. Contaminated jute bags, in a single layer, were exposed between two panels of commercial infra-red electric lamps. In the presence of considerable organic matter, exposures of not less than 90 seconds and temperatures not below 425°F. were necessary to kill the organism. Commercial quaternary ammonium compounds were effective at dilutions of 1 : 100 in killing the ring rot organism, even at low temperatures. Carboxide (10 per cent ethylene oxide) proved efficient in penetrating bales of 500 bags and effective in killing the ring rot organism in the centre of such bales. A dosage of 80 mg. per litre of space in the fumigation chamber and an exposure of 24 hours were necessary.

Parathion Residue on Cauliflower†

Although parathion is not recommended for use on cauliflower, there is a distinct possibility that some growers may use it. Residues on material gathered 13, 19 and 27 days after spraying were below

*Extracts from Agricultural Chemicals, Vol. VI, No. 9, September, 1951, p. 33.

†Extract from Report of the Minister of Agriculture for Canada for the year ended March 31, 1951. Ottawa, 1951.

0.03 parts per million of fresh weight—well below the tentatively accepted tolerance. Cooked cauliflower did not contain measurable amounts of parathion.

New Chemical Proves Effective in Controlling Plant Diseases*

Manzate, a new fungicide that protects tomatoes and potatoes against all major plant diseases, has been developed in U.S.A.

Chemically, Manzate is made of manganese ethylene bisdithiocarban ate, and is based on derivatives of dithiocarbamic acid.

This fungicide is valuable in that it offers a single treatment which is effective against all major fungus enemies in both fruit and foliage of the tomato plant. Previously two or more chemicals were required to control the various diseases.

Extensive field tests also have revealed that Manzate is particularly effective in early and late potato blights. Tests are also being made of its effectiveness in controlling diseases of apples, cereal grains, cucumbers, squash, melons and celery.

Radio Waves Help in Storing Grain†

The results of experiments with radio frequency heating for dying and conditioning grain were reported recently by scientists from the U.S. Department of Agriculture.

In the experimental process, radio frequency energy is passed through the grain, radio waves causing friction which produces heat within the grain kernels. In ordinary heating procedures only the surface of the kernel is heated. Scientists see possibilities not only of more efficient drying, but also of reducing the bad effects of bacteria, mould spores, insects and enzymes that often cause damage when the grain is stored.

The radio frequency process is also known as dielectric heating. (U.S.A. In Review, 13th July 1951).

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*Extract from American Agriculture, No. 52-A-3, dated January 30, 1952, page 12.

†Extract from Science News Letter, No. 35, dated 20th July 1951, issued by the Scientific Adviser, India House, London.

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